

**Amendments to the Specification:**

Please delete paragraph 0002 and insert:

[0002] In recent years polyolefins such as polypropylene ~~has~~have gained increasing popularity as thermoplastic molding materials for making a great variety of molded objects. Because polyolefins such as polypropylene offers a unique combination of low density, abrasion resistance, good chemical resistance, relatively high softening point and low cost, these polymers are good candidates for use as fiber reinforced thermoplastic compositions. Reinforcement by fibers such as glass and the like offer compositions with better stiffness, impact resistance and heat resistance than their unreinforced counterparts. Thus, reinforced polyolefins such as polypropylene continue to gain acceptance for use in various industry parts such as automobile parts and electrical parts.

Please delete paragraph 0007 and insert:

[0007] It has widely been held that kneading processes are such that the polymer produced is one which will contain reinforcing fibers which have an average length of 0.25 inch or less with few, if any, long fibers distributed in the matrix. This absence of long fibers can adversely effect the strength and overall performance of the over the resulting reinforced polymer. Thus, it would be desirable to provide a process for producing a reinforced polymeric material having elevated levels of long levels of long fibers.

Please delete paragraph 0017 and insert:

[0017] Parts made from the resulting reinforced polymeric material ~~has~~have a tensile strength at break at least 20,000 psi and preferably ~~has~~have at least one cantilever. Parts made according to the present invention from the resulting polymeric material contain a melt processible thermoplastic material having a melt flow index of at least 25 g/10 minutes and reinforcement fibers having a cumulative length distribution frequency in which at least 5% of the fibers have lengths 10 mm. The reinforcement material has a sizing compound associated therewith which includes at least one polymer from the group including polyurethane, polyurea, and isothiocyanate derivatives thereof. The reinforcement material is present in the

thermoplastic material in an essentially uniformly dispersed manner in an amount greater than 30% by weight such that individual fibers are oriented in a filamentized manner in the thermoplastic matrix.

Please delete paragraph 0028 and insert:

[0028]           The preferred thermoplastic for use in the process and molded device of the present invention contains a polyolefin and has the enumerated characteristics. In the most preferred embodiment, polypropylene is advantageously employed along with functionalized polyolefin. Functionalized polyolefins which can be employed in the process of the present invention can be referred to as anhydride-functionalized polyolefins. Typically materials such as maleated polypropylene or acrylated polypropylene are advantageously employed in various combination concentration ratios with the polypropylene in the process of the present invention. It is to be understood that the material of choice may be a polyolefin, polyolefin blend or the like and may ~~contains~~ contain such additives as would not impede or interfere with the process or the performance of the resulting molded part. The thermoplastic material may contain additives, which can normally be used in processing thermoplastic materials, such as fillers, e.g., talc, as well as materials such as pigments, antistatic agents, and antioxidants. Characteristics of a suitable polypropylene are set forth in Table I.

Please delete paragraph 0031 and insert:

[0031]           Glass fibers which can be employed in accordance with the present invention are fibers of E-glass, S-glass, C-glass, AR-glass, T-glass, D-glass, R-glass or the like. Glass fibers having a random lengths of at least 0.375 inch are suitable for use in the process and molded part of the present invention. In the preferred embodiment, the fibers will have a length distribution which is favors longer fibers such that the minimum general length for reinforcing fibers is at least 0.5 inches. The fibers will typically have width and thickness dimensions which will facilitate filamentization of the fibers ~~with in~~ within the solid thermoplastic material during the admixing step. Preferably, the reinforcing fibers are ~~preferably~~ flat planar pieces

having a thickness between 0.01 inch and 0.1 inch and a thickness between 0.05 and 0.15 inch.

Please delete paragraph 0032 and insert:

[0032] Reinforcement fibers used in accordance with the present invention must be surface-finished with a finishing agent typically referred to as a sizing. Unsized reinforcement fibers, particularly glass fibers have a hydrophilic nature and therefore exhibit low wettability with thermoplastic resins having a lipophilic nature such as polypropylene. This can result in large surface tension ~~between~~ or surface energy values between such glass fibers and polypropylene such that the glass fibers cannot easily be dispersed with the polypropylene resin. Resulting masses of glass fibers unimpregnated with the resin during molding operations can cause external appearance defects and tensile strength reduction.

Please delete paragraph 0034 and insert:

[0034] Preferably the sizing composition contains at least one of a polyurethane, and polyurea. By the use of the term polyurethane, it is meant to include reaction products of organic compounds having at least two active hydrogens and di and/or polyisocyanates, wherein the resulting polymer is an film forming polyurethane or polyurea type polymer. By film forming, it is meant that the film of the polyurethane or polyurea alone has a hardness of about 10 shore A to about 75 to 80 shore D with a preferred hardness of shore A 60 to 100 and elongation on the order of 5 to 800 percent. The Shore hardness test is conducted on a Shore durometer by standard procedures, and elongation is measured in accordance with ASTM testing procedure, D412. Preferably, the organic compounds with at least two active hydrogens is a polyol such as a polyolefin polyol, polyalkene diol and polyalkane diols, polyester polyol or polyether polyol and, most preferably, a polyol which is linear. Examples of polyester-based polyurethane elastomers include those where the polyester is prepared from carboxylic acid such as adipic and the glycol portion can be selected from such materials as ethylene glycol, 1,2-propylene glycol, 1,3-butylene glycol and 1,4-butylene glycol which alone can be used as chain extenders. Further examples of polyfunctional polyesters which can be used are those based on phthalic

anhydride, adipic acid, ethylene glycol, trimethylol propane, and the like. Examples of polyalkene diols include polybutadiene diol, polyisoprene diol. Examples of polyalkylene diols include polybutene diol. It is contemplated that the material may possess no branching of the polyol. It is also contemplated that a slight amount of branching of the polyol can be tolerated but the degree of functionality or branching of the polyol should be kept to a minimum since increased branching results in films results in film embrittlement.

Please delete paragraph 0035 and insert:

[0035] The di- or polyisocyanates generally used to form the polyurethane or polyurea are selected from aromatic, aliphatic and mixtures thereof, isocyanates and/or isothiocyanates, but the aliphatic isocyanates are preferred. Examples of the polyisocyanates that can be used include the aromatic isocyanate of toluene diisocyanate and the aliphatic isocyanates such as hexamethylene diisocyanate, methylcyclohexylene diisocyanate, dicyclohexyl methane diisocyanate, lysine diisocyanate where the aliphatic group is methyl or ethyl, bis(2-isocyanato ethyl) fumarate, bis(2-isocyanato ethyl) carbonate and dimeryl diisocyanate, where the organic group is essentially a C<sub>36</sub> hydrocarbon radical. Another isocyanate that may be used is 4,4'-diphenyl methane diisocyanate. The polyurethane polymer can be made as a curable material by any method known to those skilled in the art, for instance, additional monomers like diisocyanate, polyols or epoxies can be added to the polymer and/or a curable moiety can be introduced into the polymer. Nonexclusive examples of the aforementioned reactive groups or moieties used to make the curable polyurethane elastomer are hydroxyls, epoxies, ureas, amines, amides, and olefinic groups, or reactive methylene or olefinic groups. The polyurethane polymers can be produced by any one-shot or single step method known to those skilled in the art or by the two step chain extension process utilizing linear or lightly branched polyols with the necessary molar portions of the diisocyanate known to those skilled in the art to produce a water dispersible polyurethane. It is to be understood that one or more of the these various film forming polyurethanes can be used in the sizing material. Particularly, two or more of the polyurethanes or polyureas or combination of the two can be blended to achieve a desired hardness

and/or elongation and/or a desired degree of abrasion resistance property for the coating on the sized glass fibers.

Please delete paragraph 0036 and insert:

[0036] Nonexclusive examples of the polyurethane polymers that can be used as the film forming polymers in the impregnating coating include those that are internally emulsified. Other types of polyurethane polymers that can be used are those having ionic groups present on the polymer molecule ~~Other~~ It is also contemplated that other types of polyurethane ionomers, e.g. polyurethane polymers having ionic groups present on the polymer, that can be ionically cross linked can be used in the composition of the present invention. These include polyurethane ionomers. Nonexclusive examples of the polyurethane ionomers include materials produced by reacting organic diisocyanates having molecular weights of from about 160 to about 300 with tri and/or tetra alkylene polyol such as ethylene glycol, and, optionally, other aliphatic glycols having molecular weights of from about 62 to about 200 in the presence of glycols containing carboxyl, carboxylate, sulfonic acid and/or sulfonate groups and having a molecular weight of less than around 500. These polyurethane polymers containing the ionic groups or hydrophilic polyether segments are self-emulsifiable and do not need emulsifiers or high shear forces to be emulsified or dispersed, since they are self-dispersing. ~~Also~~ It is also contemplated that cationic polyurethanes ~~that are formed by~~ quaternizing polyaddition reactions can be used. Combinations of the ionic polyurethanes with polyesters, polyethers, polyacetals, polyisocyanates, low molecular weight glycols and diamines can also be used. The type and amount of the ionic groups present in the ionic polyurethanes are selected so that the polyurethane is not only self-dispersing but that the particle size of the polyurethane is less than around 5 microns.

Please delete paragraph 0037 and insert:

[0037] Typically, glass fiber material will be presized with suitable urethane-containing compositions of the type previously enumerated. This invention is predicated, at least in part, on the unexpected discovery that reinforcement fibers of the type described herein, when sized with a urethane-containing material of the type

enumerated, will resist deformation and breakage during compounding and processing. The ~~result~~resulting injection molded articles exhibit superior strength and durability when incorporated into a polymeric matrix, particularly in a polypropylene matrix.

Please delete paragraph 0039 and insert:

[0039] Molded parts prepared by the process of the present invention are characterized by a highly oriented or ordered positioning and distribution of reinforcement fibers length relative to fluid flow into the associated mold cavity. It has been found that uncommonly long length fiber reinforcement material can be successfully introduced into a suitable mold cavity thorough an injection molding process. The ~~reenforcement~~reinforcement material can be oriented relative to the fluid flow in a manner which provides increased reinforcement and material strength, particularly at angularities such as beams and cantilevers.

Please delete paragraph 0041 and insert:

[0041] In order to process the material according to the present invention a suitable compounding apparatus 10 is employed as depicted in Fig. 1. In order to filamentize the reinforcement fibers relative to the solid glass material, the two components are preferably introduced into a low intensity mixing chamber 12 such as a ribbon blender as shown in Fig. 2. The low intensity mixing chamber 12 is one which will permit the ordered fluidization of the introduces solids. By "ordered fluidization" it is meant that the reinforcing fibers are uniformly dispersed in the solid polymeric material in a manner which achieves appreciable orientation of the ~~reenforcement~~reinforcement fibers relative to the induced fluid flow.

Please delete paragraph 0042 and insert:

[0042] Preferably, this is achieved by the positioning of at least one rotation-inducing central impeller 13 having vertical spiral vane<sub>14</sub> extending outwardly therefrom toward the outer wall 16 of the ribbon mixing chamber. It is believed that the vertical spiral vane<sub>14</sub> serves to comb and orient individual reinforcement fibers relative to the directional flow of the fluid. Without being bound to any theory, it is

believed that the shape of the reinforcement fibers facilitates both lift and orientation of the fibers when subjected to the forces in the ribbon mixer.

Please delete paragraph 0045 and insert:

[0045]                The ~~reenforcement~~ reinforcement fiber can be introduced into the ribbon blender through a suitable conduit such as auger pipe 22. Associated with the auger pipe 22 are suitable optional metering devices to control rate and manner of introduction (not shown). As with conduit 20, associated with the reinforcement material introduction conduit 22 can be associated with suitable drying mechanisms (not shown) etc as required or desired to effect drying or other material handling requirements.

Please delete paragraph 0046 and insert:

[0046]                Without being bound to any theory, it is believed that the agitated polymeric material and the associated agitated oriented reinforcement fiber mechanically interact such that an appreciable number of the reinforcing fibers filamentize in a linear manner which assists in maintaining suitable fiber orientation throughout subsequent processing up to and including introduction into the mold cavity. It was found, quite unexpectedly, that thermoplastic moldings having reinforcement fibers dispersed throughout the solid polymeric material in an linear or radial orientation essentially parallel to one another have greatly enhanced strength and performance characteristics. While various attempts have been made to orient fibers in plasticized materials during the compounding process, these have met with limited success. Many have failed to achieve significant levels of fiber orientation with concomitant polymeric orientation. Most have not successfully compounded long or uncommon length fibers. Typically any attempt to comb or orient fibers during a melt kneading process is directed at undoing bending and matting of fibers induced during the compounding action. It has been found, quite unexpectedly, that induction of ordered direction of uncommon length fiber such as filamentization while the respective reinforcement fibers and polymeric material are in the dry state prior to introduction into a plasticization device results in lower fiber distortion,

breakage and/or disorientation during plasticization and subsequent introduction into a mold cavity.

Please delete paragraph 0048 and insert:

[0048] Preferably, the ribbon blender 14 also includes a suitable mechanism ~~28~~ 27 for obtaining samples of the agitated solids mixture. Such sampling mechanism is typically located proximate to the point at which the agitated material exists the ribbon blender. The sampling mechanism ~~28~~ 27 can be any suitable automated or non-automated mechanism for ascertaining the effectiveness of the fluidization process and/or obtaining physical samples of the material so processed. Thus, the sampling mechanism 27 can include means for visually ascertaining the process. Preferably, the ribbon blender 14 includes a door or portal proximate to the material exit point which will permit collection of a sample of suitable volume for analysis and retention.

Please delete paragraph 0049 and insert:

[0049] The collection and exit means from the ribbon blender 14 can be facilitated by any suitable mechanical or architectural elements which will facilitate the smooth and rapid movement of the agitated and filamentized solids product from the ribbon blender 14. While it is anticipated that various mechanical aids can be employed, in the process as depicted in the present application, the agitated material is collected and dispersed from the ribbon blender 14 by means by any suitable means. It has been found that sufficient mechanical energy has been imparted to the agitated mass by means of the action of the ribbon blender that the ordered filamentized relationship of thermoplastic polymer to reinforcement fiber is not significantly disturbed during the gravity feed process and conveyance into the plasticizing apparatus.

Please delete paragraph 0051 and insert:

[0051] The process of orientation and blending preferably occurs at a temperature below that which impedes further and subsequent processing. It is preferred that the temperature be maintained below the point at which deleterious sintering occurs. ~~†~~The melt temperature of the thermoplastic polyolefin material.



Preferably, the temperature occurs at or near ambient room temperature, i.e. between about 68° and 72° F with no additional heat being supplied to the ribbon blender vessel. It is to be understood that material introduced into the ribbon blender 14 may retain shear heat from the blending process. However such retained heat is to be tolerated in the fluidization and orientation process occurring in the ribbon blender. It has been that the material so processed in the ribbon blender 14 of the present invention retain orientation even after completion of processing in the ribbon blender. This permits flexibility in processing and product flow. It is conceivable that material produced in the ribbon blender can be stockpiled and further processed as desired or required.

Please delete paragraph 0052 and insert:

[0052] It is also to be understood that the act of fluidization and blending can generate discrete temperature elevations in the blended material. However, any temperature elevation which may occur due to either frictional interaction and/or introduction of retained heat is below that at which the thermoplastic material experiences significant, if any, melting events. Thus, in the preferred embodiment, the material which exits the ribbon blender 14 is a agitated mixture of thermoplastic material in a pelletized or granulated form with discrete lengths of reinforcement fiber dispersed essentially uniformly therethrough in a filamentized arrangement in which the reinforcement fibers are oriented in essentially parallel end to end relationship to one another and increased spacing between the fibers resulting in the increased presence of void spaces.

Please delete paragraph 0053 and insert:

[0053] The compounding device 24 to which the prepared material is conveyed can be generally described as a continuous plasticizing and compounding vessel. The plasticizing vessel employed in the present invention includes at least one screw capable of accomplishing knead melt operations. The apparatus is one which is capable of continuous production of fiber reinforced thermoplastics. The device preferably includes at least one three stage zone extruder screw an example of which is depicted in Fig. 3. The ~~plasticizing-compounding~~ device 24 is one which has a feed

zone, a transition zone and a metering zone. These zones may be of sufficient length to operate on the agitated material introduced into the plasticizing apparatus.

Please delete paragraph 0054 and insert:

[0054] In the preferred embodiment, the compounding device 24 will employ a screw having a length to diameter ratio of 18 to 32 inch with a length to diameter ratio of 19 to 20 inch being preferred. It can be appreciated that in typical compounding and plasticizing operations, screws having a length to diameter ratio in excess of 25 are employed. It has been believed that such protracted processing intervals as would ~~be incurred~~ occur in devices having elevated length to diameter ratios were necessary to obtain proper dispersion of the ~~reenforcement~~ reinforcement fibers in the polymeric matrix. However it has been found quite unexpectedly that shorted process intervals as would result from the use of devices having screws with shorter length to diameter ratios can be successfully employed in the process of the present invention. Without being bound to any theory, it is believed that this is due, at least in part to the orientation and dispersion of fibers which occurs prior to introduction of the material into the plasticization device.

Please delete paragraph 0055 and insert:

[0055] In the process and device of the present invention, the plasticizer/extruder may be of standard construction with the exception of the screw configuration. In general, the plasticizer includes a barrel portion 28 defining a central cavity surrounding the screw 30. In the process and device of the present invention, the screw 30 will have a configuration capable of producing an initial processing region of low compression. As used herein "low compression" is defined as a compression ratio between 2.0:1 and 2.9:1.

Please delete paragraph 0058 and insert:

[0058] Extrusion of processed material preferably occurs directly into a suitable device ~~(52)~~ 52 having a closed mold cavity while the material is still in its moldable state. Such closed mold devices are typically employed in injection mold operations. Additionally, the compounding device 24 can include suitable vents such

as vent 48 and the like to remove volatiles as well as devices to regulate internal atmosphere (not shown) and the like as desired or required.

Please delete paragraph 0059 and insert:

[0059] In the process of the present invention, the extruder screw 32 is configured so device 24 has a compression ratio of between 2.0:1 and 2.9:1. It can be appreciated that this compression ratio is significantly lower than standard compression ratios typically found in various conventional plasticizing apparatuses ~~which that typically runs run~~ between 3.0:1 or higher. Without being bound to any theory, it is believed that the lower compression ratio promotes initial melting of the thermoplastic material in a manner which maintains the filamentized orientation of the reinforcement fibers relative to the melting polymeric material. Heretofore it was believed that higher compression ratios were required to achieve uniform melt and adequate dispersion of reinforcement fibers in the melting polymeric material.

Please delete paragraph 0063 and insert:

[0063] In the screw configuration of the present invention, the feed 48, transition 50 and metering 56 ~~sections-zones~~ of the screw 24 are present in specific ratios. The feed section 48 is of a length which accomplishes conveyance of the introduced material into the transition zone 50. ~~stage.~~ The feed section 48 includes suitable heat sources such as heater bands (not shown). Due to the low constant compression ratio, little if any melting occurs in this section. The length of the feed section will comprise between 20.0 and 30.0 % of the total screw length, with a length of 23.0% to 28.0% being preferred. The transition ~~section-zone~~ 50 is of a length which will accomplish melting and suitable compression elevation. The transition ~~section-zone~~ 50 also includes a suitable source of added heat such as heater bands. The temperature of the transition ~~section-zone~~ 50 is above that of the feed ~~section-zone~~ 48. The length of the transition ~~section-zone~~ 50 will comprise between 40 and 70 % of the total screw length, with a range between 47 and 67 % being preferred. The metering zone 56 has a length sufficient to accomplish mixing and proper alignment of the fibers for proper entry into the closed cavity mold. The metering ~~section-zzone~~ 56 has a length which comprises between 9.0 and 26% of the total screw length.

Total screw length is the length of the processing portion of the screw exclusive of the spline.

Please delete paragraph 0064 and insert:

[0064]                The ~~plasticizing apparatus~~compounding device 24 of the present invention may include suitable means for providing heating to the plasticizing chamber. Such heating can include, but is not limited to, heating caused by the action of the mixing screw 30 and/or the chamber itself. It is also within the purview of this invention that external heat be employed at locations which facilitate melting and processing.

Please delete paragraph 0065 and insert:

[0065]                Thus, the melt kneading event which proceeds in the ~~plasticizing chamber~~compounding device 24 is accompanied by temperature elevations. The temperature achieved in the plasticizing chamber is one which will permit melting of the introduced thermoplastic pellets but will be below the temperature which would cause appreciable thermoplastic decomposition. "Appreciable decomposition" is defined herein as oxidation, chain scission or other chemical breakdown which in an amount or at a level which would impair the end function of the reinforced material produced by the process of the present invention. Generally, the maximum melt temperature achieved in the plasticizing chamber in the process of the present invention will be between 450° F and 650° F. It is to be understood that the melt temperature as defined therein is the temperature at exit from the nozzle.

Please delete paragraph 0066 and insert:

[0066]                In the process and apparatus of the present invention, it is believed that the material experiences a temperature elevation gradient as it is conveyed through the ~~plasticizing apparatus~~compounding device 24. Thus, the temperature maximums are experienced at or near the exit point from the apparatus. Without being bound to any theory, it is believed that the temperature gradient permits the optimum thermoplastic viscosity for plasticization of urethane/polyurea-containing sizing contained on the reinforcement fibers. In this manner, the oriented reinforcement fibers are flexibly

conveyed in a filamentized fashion in the mixture through the initial melting stages but are subject to a brief interval of temperature sufficient to melt the urethane.

Please delete paragraph 0070 and insert:

[0070] As indicated previously upon completion of plasticization and knead melting, once the material has been processed and compressed, the material is expelled from the barrels region of the ~~plasticizer compounding device~~ 24 and introduced into a closed cavity mold device 524. The mold device ~~5452~~ will be any one capable of forming the desired end use part and thus will have suitable negative indentations etc to form the geometric surfaces required or desires in the finished part. The closed cavity mold is one which would typically be familiar to those skilled in the art of injection molding. As such the closed cavity mold can be prepared with materials such as mold releases agents and the like to facilitate the molding process. However while these agents may be desirable and/or required in the molding technology, they are generally considered tangential to the disclosure of the present invention.

Please delete paragraph 0071 and insert:

[0071] The closed cavity mold device 52 employed may have two or more mating die pieces as would be desired or required. In the process of the present invention, the melted polymeric material with the reinforcement fibers contained therein in a dispersed and oriented relationship to fluid flow, is introduced into the closed mold cavity in an manner which directs and the flowing material in an efficient and effective manner.

Please delete paragraph 0072 and insert:

[0072] Typically the closed mold cavity device 52 will have a geometry which includes at least two primary planes at angular orientation to one another. The mold cavity will have at least one entry point for the reinforced polymeric material preferably at a location which helps maintain a sufficient degree of the filamentized orientation, either radial or planar, of the reinforcing fibers through critical geometric regions in the finished part. Thus with reference to the battery mounting bracket 100 shown in Figs. 4-6, a mold cavity entry point is preferably located at a position

essentially central to the rear wall 102 and angular to the bottom support surface 104. The entry point can be discerned in the battery mounting bracket 100 in Figs. 4-6 as mold entry vestige 106 that is trimmed (shown in phantom).

Please delete paragraph 0073 and insert:

[0073] Without being bound to any theory, it is believed that the reinforcement fibers enter the closed mold cavity encapsulated or encased in the surrounding polymeric matrix material in the oriented filamentized manner described previously. Upon entry through a suitable entry port, the fluid flow is diverted in an ordered fashion by internal geometries of the mold cavity and flow characteristics of the introduced material. Thus the material flows through angularities and ribs in a manner which orients a sufficient number of uncommon length reinforcement fibers in a manner which maximizes reinforcement strength. Typically, this orientation is essentially perpendicular or radial to and across the angle formed in the molded part. Perpendicular orientation typically occurs in end-gated closed cavity molding processes, while radial orientation typically occurs in center-gated closed cavity molding processes. It is believed that the oriented fibers conform to flow patterns induced in the cantilever mold. Therefore, the fibers located at the contiguous junction of cantilever to mold wall are oriented in a linear fashion which conforms to the cantilever geometry. Because the fibers have a significant linear orientation, it is theorized that the load experienced by the cantilevered part floor is effectively transferred through the glass fibers into the mounting wall and associated engine compartment frame structure to which the bracket is mounted.

Please delete paragraph 0080 and insert:

[0080] The battery support bracket 100 as depicted in Figs. 4-6 also includes a suitable mounting extension 116 to house various wiring components. The mounting extension extends outward from the opposed side wall 112'.